NOAA-DOE Precipitation Processes and Predictability Workshop

LUNCH TIME SLIDE REEL, WE WILL RETURN AT 1:00 PM (est)

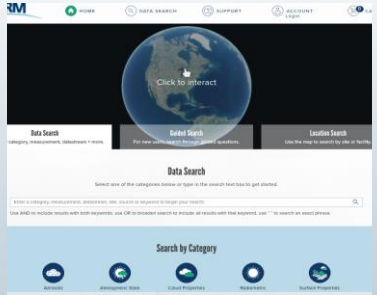
The DOE Atmospheric Radiation Measurement (ARM) User Facility

Measurements of clouds, aerosols, precipitation, radiation, surface properties and the atmospheric state since 1992

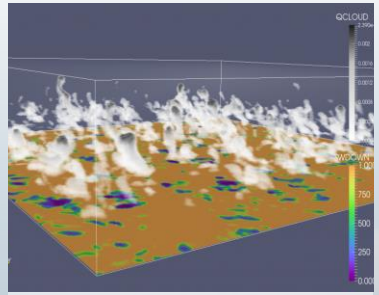
Support for process studies and model development

Network of 3 fixed-location & 3 mobile observatories

Piloted & unmanned aerial measurement platforms



Extensive data management infrastructure



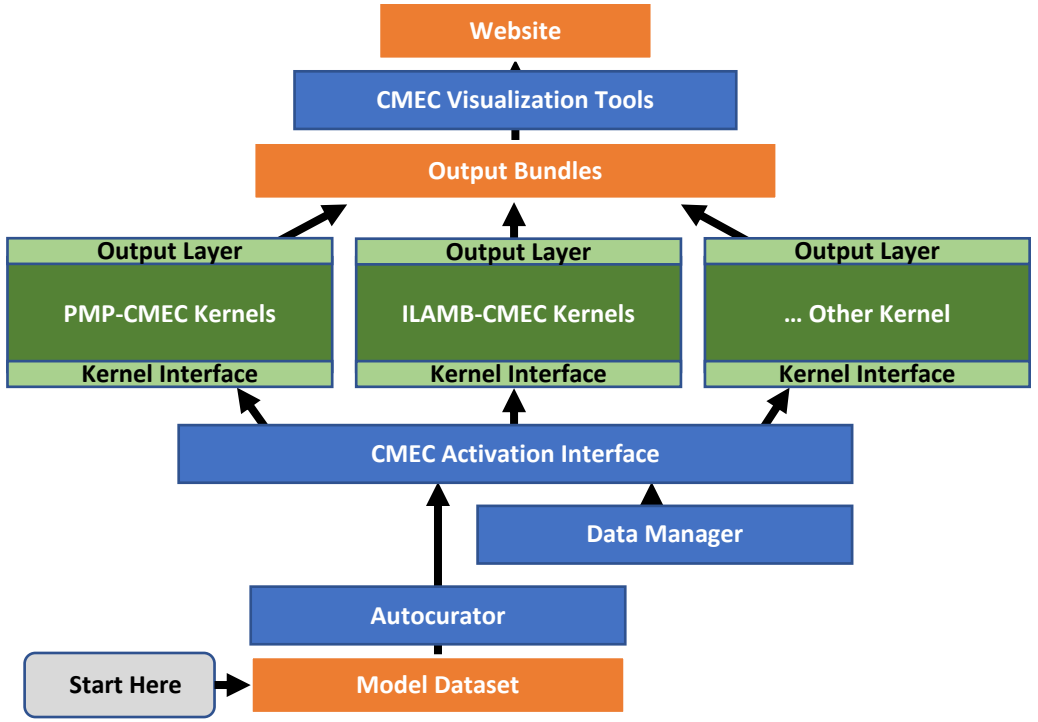
Large-eddy simulation (LES) model simulations & analysis tools

Freely available data products in standard format

https://www.arm.gov

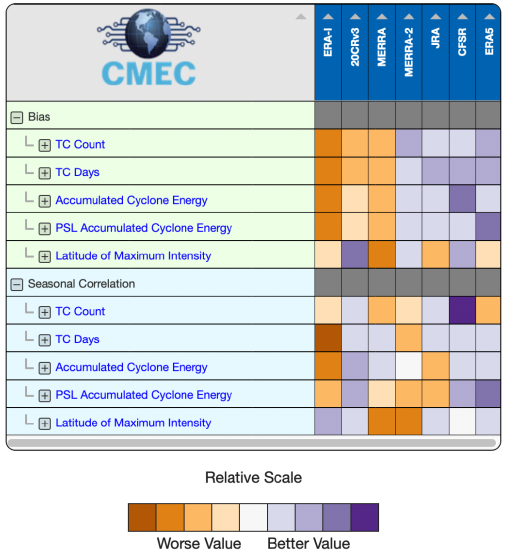
Coordinated Model Evaluation Capabilities

CMEC is developing a unified workflow that enables multiple evaluation packages to be executed from a single unified interface, and results examined together.



Project Goals

1. Develop robust **standards** for the development of metrics and diagnostics packages.
2. Develop accompanying tools for **coordinated execution** of metric packages and **visualization of / interaction with** metrics and diagnostics package output.
3. Build **connections across projects and agencies** related to model evaluation activities.



CMEC supports a comprehensive software suite for analysis of model evaluation output, including both climate data metrics and diagnostics.

Contact Paul Ullrich
paullrich@ucdavis.edu

How are stakeholders using climate data? What are stakeholder needs for climate data?

Use-Inspired Metrics

How well do Earth-system models, integrated human-Earth system models, and available datasets perform for relevant quantities?

Stakeholder Engagement

U.S. Department of Energy | Office of Science

HYPERFACETS

A Framework for Improving Analysis and Modeling of Earth System and Intersectoral Dynamics at Regional Scales

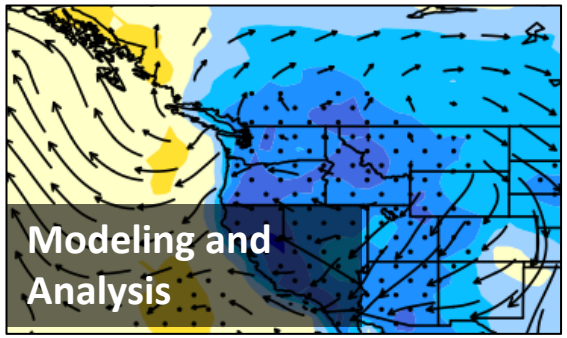
Process Understanding

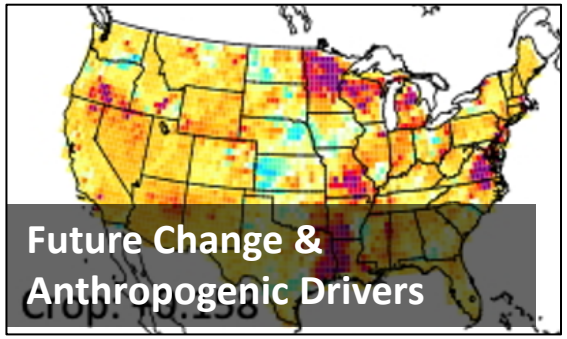
What are the drivers and processes that are most important for ensuring model performance?

What role does human activity (GHG vs. land-use) play in affecting these quantities?

How credible and salient are Earth-system models and available datasets for stakeholder need?

Expert Guidance

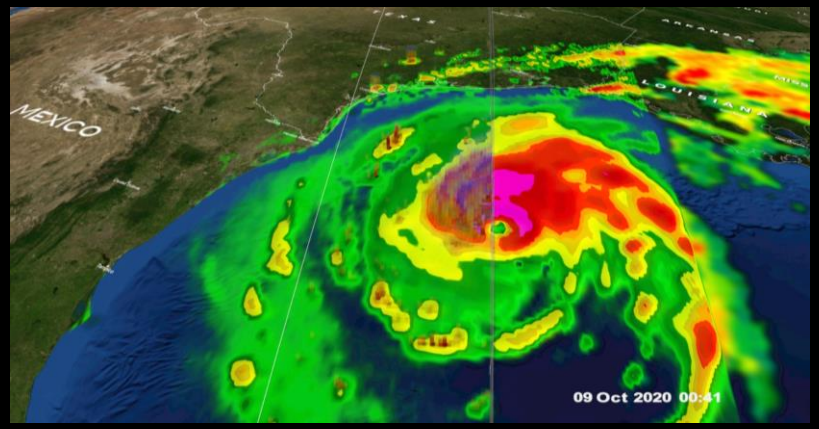




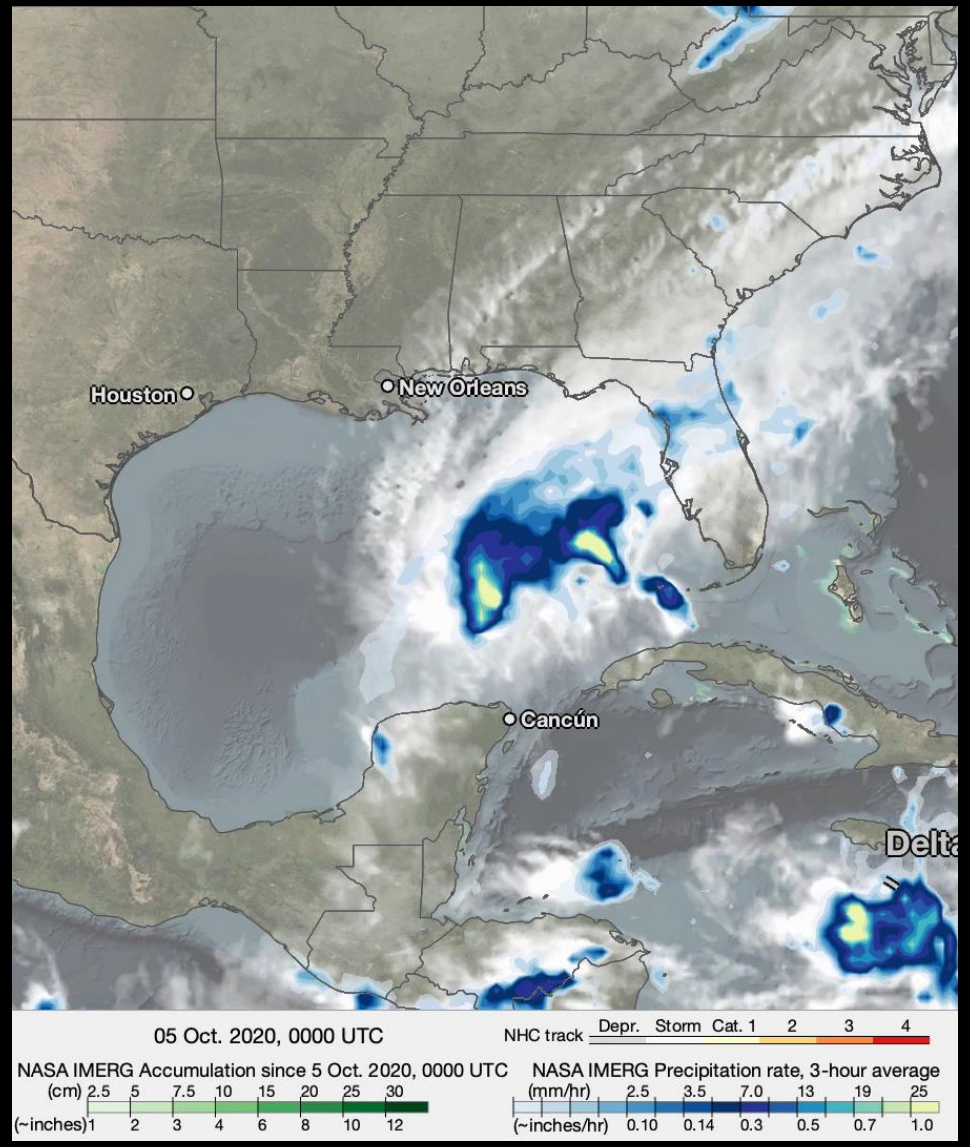
Global Precipitation Measurement (GPM)

Goddard Space Flight Center Science

- GPM carries the Dual-frequency Precipitation Radar (DPR) and the GPM Microwave Imager (GMI).
- GPM provides the critical calibration reference for a constellation of ~11 precipitation-measuring satellites that enable high spatial and temporal resolution rainfall products such as the GPM IMERG product.
- IMERG tracks the instantaneous rainfall over the life cycle of storms as well as the total accumulation along the storm's path.



GPM overpass of (left) and IMERG rainfall rate and accumulation for (right) Hurricane Delta



https://gpm.nasa.gov/applications/weather/gpm-captures-hurricane-delta-approach-gulf-coast

SCOR WG #162 for developing an

Observing Air-Sea Interactions Strategy (OASIS) for 2030

airseaobs.org

Meghan F. Cronin (NOAA PMEL)

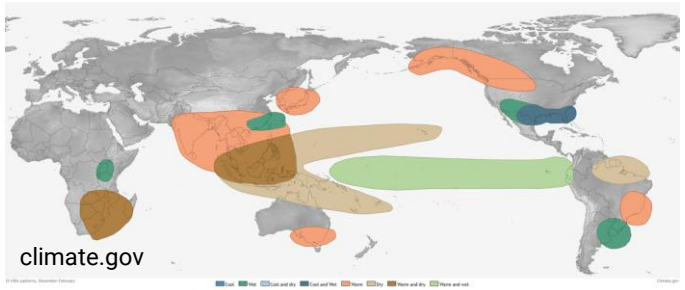
A "system-as-a-whole" approach for making surface and boundary layer observations relevant to the Earth's energy, water, and carbon cycles, including their physical, biological, and geological components.

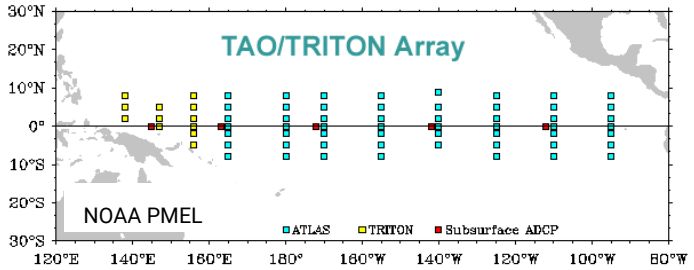
Integrating recommendations from
>36 OceanObs19 community strategy papers &
>400 authors

Tropical Pacific Observing System

- TPOS 2020 (www.tpos2020.org) is an international effort that has proposed a redesign for the Tropical Pacific Observing System to be more capable, resilient and multidisciplinary, that are critically important to improving subseasonal and longer forecasts
- The redesign takes full advantage of the synergy of buoys, satellites and new autonomous instruments to propel end-to-end advancement of forecast systems.
- The TPOS project advanced connections between the the modeling, research, and observing communities. These connections will continue to update the observing system, advance research, and improve assimilation and models.
- TPOS recommended field studies and process-oriented research will further bridge the gap to model improvements and predictions.
    - The TPOS Final Report will be published in early 2021.

El Nino Global Impacts



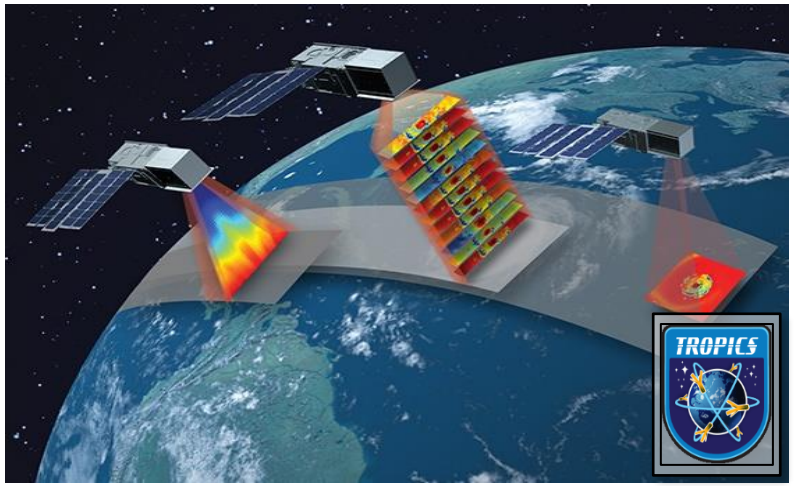


Buoys **Satellites** **Argo**

www.tpos2020.org

TROPICS: Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats

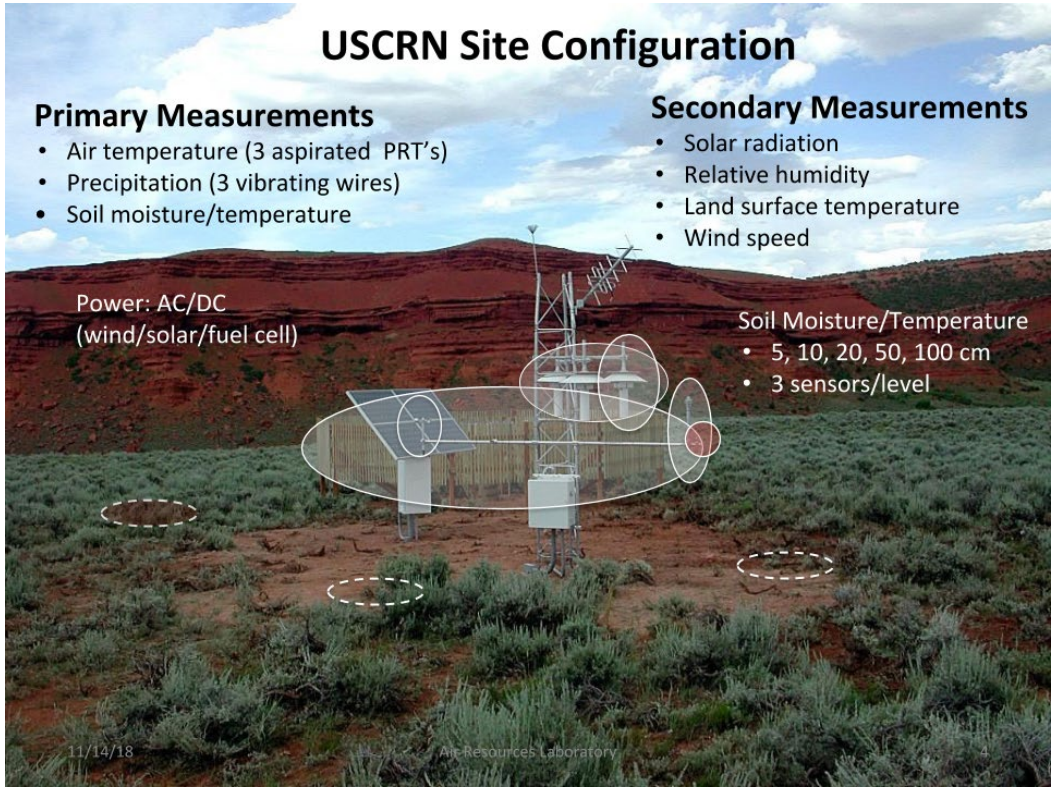
- NASA Earth Venture Program led by MIT Lincoln Lab
  - Principal Investigator: Dr. William J. Blackwell
  - Project Scientist: Dr. Scott A. Braun (NASA GSFC)
- Innovative solution to provide high-revisit rainfall, temperature, and moisture data for tropical cyclone studies
- Constellation of six 3U cubesats
  - 2U spacecraft bus from Blue Canyon Technologies
  - 1U multi-channel passive microwave radiometer payload from MIT Lincoln Laboratory
  - Frequencies include 7 sounding channels near 118 GHz, 3 near 183 GHz, and imaging at 89 and 205 GHz
- Pathfinder mission (one cubesat) to launch June ’21
- Constellation mission (six cubesats) to launch early ‘22



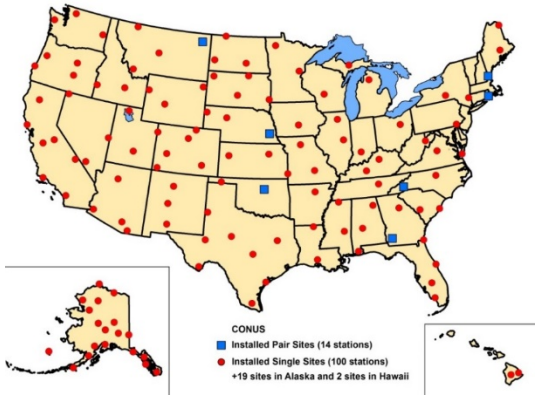
LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

U.S. Climate Reference Network (USCRN) - https://ncdc.noaa.gov/crn

Howard J. Diamond, PhD – USCRN Program Manager - howard.diamond@noaa.gov



CONUS – Completed in 2008 (114 stations) plus 2 stations in Hawaii

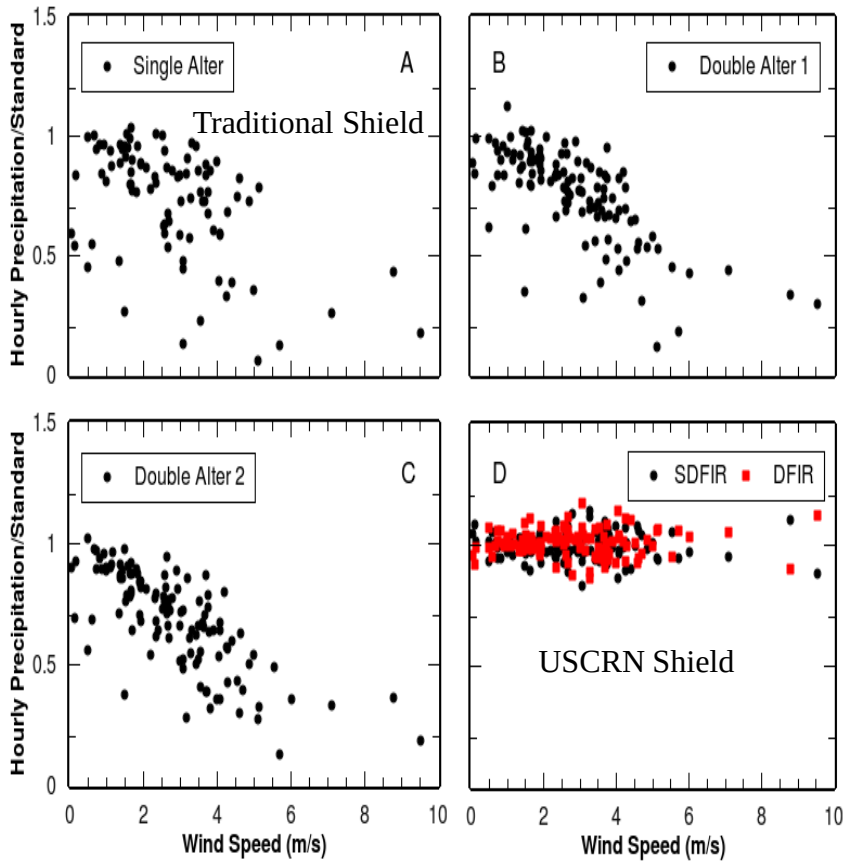


23 stations installed as of Sep 2019

U.S. & Alaska Climate Reference Network
Precipitation Measurements

How Well do we Measure Snow??

USCRN Precipitation Testbed



C. Bruce Baker, Senior Scientist
NOAA/OAR/ARL

The **SURFRAD** Network began operations in 1995 and continues to collect data today in seven climatologically diverse regions of the U.S.

NOAA's Surface Radiation Budget Network

SURFRAD

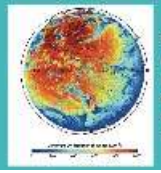
NOAA OAR
Global Monitoring Laboratory
325 Broadway
Boulder, CO 80305

The Department of Commerce
National Oceanic and Atmospheric Administration

The SURFRAD network measures the radiation budget at the surface that drives weather and climate

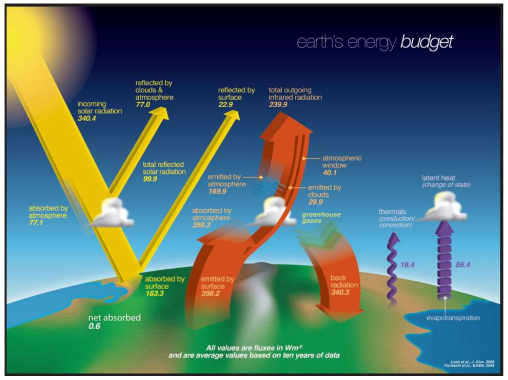
SURFRAD DATA HAVE MANY APPLICATIONS

A mobile SURFRAD station was deployed at Red Lake, Arizona to validate the new GOES Advanced Baseline Imager.



SURFRAD data are used regularly to validate NESDIS operational surface shortwave estimates from GOES.

Contact John Augustine (john.a.augustine@noaa.gov) with **SURFRAD** questions.



Quality assurance measures such as annual instrument exchanges and frequent calibration are incorporated into the design and operation of the SURFRAD network for continuous, high-quality products.

Large-scale Precipitation Tracking (LPT) for Observational Analysis and Model Evaluation

Shuyi S. Chen (shuyic@uw.edu) University of Washington

JGR Atmospheres **Kerns and Chen (2016, 2020)**

RESEARCH ARTICLE
10.1029/2019JD032142

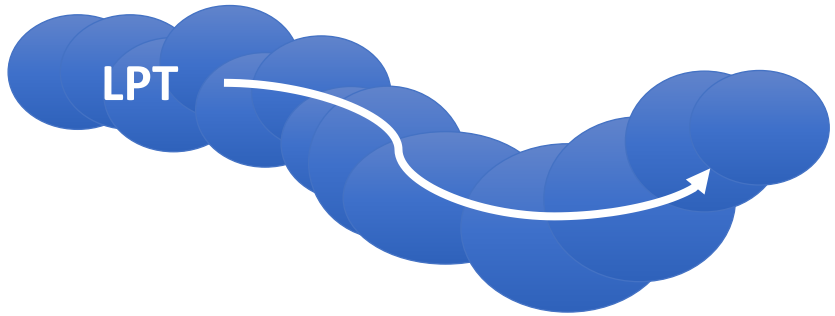
Special Section:
Years of the Maritime Continent

A 20-Year Climatology of Madden-Julian Oscillation Convection: Large-Scale Precipitation Tracking From TRMM-GPM Rainfall

Brandon W. Kerns[1] and Shuyi S. Chen[2]

[1]Applied Physics Laboratory, University of Washington, Seattle, WA, USA, [2]Department of Atmospheric Sciences, University of Washington, Seattle, WA, USA

Key Points:
- The MJO accounts for 40–50% of the annual precipitation over the



- Large-scale Precipitation Object **(LPO)** is identified and tracked in time and space, which represent precipitating systems such as equatorial waves, etc.
- **LPT** is used to track MJO precipitation **(Kerns and Chen 2016, 2020)**
- MJO LPTs provide **both zonal and meridional structure** that is important for global impact studies
- Challenge: Many current NWP and climate models cannot reproduce MJO convection/precipitation initiation, propagation, and spatial structure. LPT is a good model evaluation metric for understanding and improving prediction.